New Hampshire Volunteer Lake Assessment Program

2002 Bi-Annual Report for
Blaisdell Lake
Sutton

NHDES
Water Division
Watershed Management Bureau
6 Hazen Drive
Concord, NH 03301

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

OBSERVATIONS & RECOMMENDATIONS

Thank you for your continued hard work sampling the lake this season! Your monitoring group sampled once per month from May through September, and has done so for many years! As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality. Keep up the good work!

After reviewing data collected from **BLAISDELL LAKE,** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a and are naturally found in lake ecosystems, the chlorophyll-a concentration found in the water gives an estimation of the concentration of algae or lake productivity. The mean (average) summer chlorophyll-a concentration for New Hamsphire's lakes and ponds is 7.02 ug/L.

  Similar to the summer of 2001, the summer of 2002 was filled with many warm and sunny days and there was a lower than normal amount of rainfall during the latter-half of the summer. The combination of these factors resulted in relatively warm surface waters throughout the state. The lack of fresh water to the lakes/ponds reduced the rate of flushing which may have resulted in water stagnation. Due to these conditions, many lakes and ponds experienced increased algae growth, including filamentous green algae (the billowy clouds of green algae typically seen floating near shore), and some lakes/ponds experienced nuisance cyanobacteria (blue-green algae) blooms.

The current year data (the top graph) show that the chlorophyll-a concentration ***increased*** from May to July, ***decreased slightly*** from July to August, and then ***increased*** from August to September.

The historical data (the bottom graph) show that the 2002 chlorophyll-a mean is ***much less than*** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has ***not significantly changed*** (either *continually increased* or *continually decreased)* since monitoring began in **1986**. Specifically, the chlorophyll-a concentration has remained ***relatively stable*** and has been ***less than*** the state median. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

While algae is naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Therefore, algal concentrations may increase when there is an increase in nonpoint sources of nutrient loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). It is important to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.

Two different weather related patterns occurred this past spring and summer that influenced lake quality during the summer season.

In late May and early June of 2002, numerous rainstorms occurred. Stormwater runoff associated with these rainstorms may have increased phosphorus loading, and the amount of soil particles washed into waterbodies throughout the state. Some lakes and ponds experienced lower than typical transparency readings during late May and early June.

However, similar to the 2001 sampling season, the lower than average amount of rainfall and the warmer temperatures during the latter-half of the summer resulted in a few lakes/ponds reporting their best-ever Secchi-disk readings in July and August (a time when we often observe reduced clarity due to increased algal growth)!

The current year data (the top graph) show that the in-lake transparency ***increased*** from May to June, ***decreased*** from June to July, and then ***gradually increased*** from July to September. As discussed previously, due to the lower amount of rainfall and the reduced amount of tributary flow during the latter-half of the summer, the transparency in many lakes/pond increased

The historical data (the bottom graph) show that the 2002 mean transparency is ***much greater than*** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) show that the mean annual in-lake transparency has ***not significantly changed*** (either *continually increased* or *continually decreased*) since monitoring began in **1986.** Specifically, the in-lake transparency has remained ***stable*** and has been ***much greater than*** the state mean. We hope this trend continues. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from NHDES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.

The current year data for the epilimnion (the top inset graph) show that the total phosphorus concentration ***decreased*** from May to July, ***increased*** from July to August, and then was ***stable*** from August to September. The total phosphorus concentration on each sampling event was ***less than*** the state median.

The historical data show that the 2002 mean epiliminetic total phosphorus concentration was ***slightly less than*** the state mean.

The current year data for the hypolimnion (the bottom inset graph) show that the total phosphorus concentration ***increased steadily*** from May to August, and then ***decreased slightly*** from July to August. The total phosphorus concentration was equal to or greater than the state median on each sampling event except for the May sampling event.

(It is important to note that the turbidity of the hypolimnion (lower layer) sample was elevated on the **August** sampling event. This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling. When the lake/pond bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, please check to make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.)

The historical data show that the 2002 mean hypolimnetic total phosphorus concentration was ***slightly greater than*** the state mean.

Overall, the statistical analysis of the historical data show that the phosphorus concentration in the epilimnion (upper layer) has ***significantly decrease*****d** since monitoring began in **1986**. Specifically, the phosphorus concentration in the epilimnion has ***decreased*** (meaning ***improved***) on average by ***approximately 3.3 %*** per sampling season during the sampling period **1986** to **2002**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

Overall, the statistical analysis of the historical data show that the total phosphorus concentration in the hypolimnion (lower layer) has ***not significantly changed*** (either *continually increased* or *continually decreased*) since monitoring began in **1986**. Specifically, the total phosphorus concentration in the hypolimnion has remained ***relatively stable*** and has been ***approximately equal to*** the state median. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. If you would like to educate watershed residents about how they can help to reduce phosphorus loading into the lake/pond, please contact the VLAP Coordinator.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**
  Table 2 lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year were ***Chrysosphaerella*** **(a golden-brown algae),** ***Asterionella*** **(a diatom),** ***and Rhizosolenia*** **(a diatom).**

  Phytoplankton populations undergo a natural succession during the growing season (Please refer to page 12 of the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds. An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance. Some species of cyanobacteria can be toxic to livestock, pets, wildlife, and humans. (Please refer to pages 12 - 14 of the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding cyanobacteria).

- **Table 2: Cyanobacteria (Blue-green algae)**
  Small amounts of the cyanobacterium ***Anabaena*** was observed in the plankton sample this season. ***This species can be toxic to livestock, wildlife, pets, and humans if a large "surface bloom" occurs.*** Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. As with the summer of 2001, we observed that some lakes and ponds had cyanobacteria present during the 2002 summer season, likely due to the many warm and sunny days that occurred this summer, which may have accelerated algal and bacterial growth. In addition, the lower than normal amount of rainfall during the latter half of the summer, meant that the slow flushing rates resulted in less phosphorus exiting the lake outlet and more phosphorus being

available for plankton growth.

The presence of cyanobacteria serves as a reminder of the lake's/pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

- **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is 6.5, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The mean pH in the ***epilimnion*** this season was **7.08,** which means that the water is ***neutral*** **(i.e.; not acidic).**

Due to the presence of granite bedrock in the state and the deposition of acid rain, the surface water of many lakes/pond in the lake is acidic. However, the pH of the epilimnion of **Blaisdell Lake** has been 7.0 (meaning neutral) or greater (meaning basic, or alkaline) for the majority of the sampling seasons since monitoring began in 1986.

- **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the ***epilimnion*** (the upper layer) continues to remain ***moderate*** **(9.68 mg/L as $CaCO_3$)** and is ***greater than*** the state mean of 6.7 mg/L (Table 5). Specifically, this means that the lake/pond is ***"moderately vulnerable"*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The conductivity has ***increased*** in the lake/pond and inlets since monitoring began (Table 6). Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity. It is possible that the lower than normal amount rainfall during the latter-half of the summer reduced tributary and lake flushing, which allowed pollutants and ions to build up and resulted in elevated conductivity levels.

We recommend that your monitoring group conduct stormwater sampling along the inlets with elevated conductivity (**Russell Inlet**, in particular, as well as **Billings Inlet**) so that we can determine what may be causing the increases. For a detailed explanation on how to conduct stormwater sampling, please refer to this year's "Special Topic Article" which is included in Appendix D of this report.

- **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to page 17 of the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The total phosphorus concentration ***increased* in Brown Inlet** this season. This station has had a history of ***elevated*** and ***fluctuating*** total phosphorus concentrations. The turbidity of the **Brown Inlet** sample on the August 27th sampling event was elevated, which suggests that the stream bottom may have been disturbed while sampling, or that soil erosion is occurring in this part of the watershed.

We recommend that your monitoring group conduct stormwater sampling along **Brown Inlet** so that we can determine what may be causing the increases. Again, for a detailed explanation on how to conduct stormwater sampling, please refer to this year's "Special Topic Article" which is included in Appendix D of this report.

- **Table 9: Dissolved Oxygen and Temperature**

  Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) for the 2002 sampling season. The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was ***high*** in the epilimnion and metalimnion (middle layer), however, the concentration in the hypolimnion (lower layer) was ***low***. This is a sign of the lake's/pond's aging and declining health. Please refer to the Table 10 discussion for a more detailed explanation.

- **Table 10: Historical Hypolimnetic Dissolved Oxygen**

  Table 10 in Appendix B shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer).

  The dissolved oxygen concentration was ***low*** at the deep spot of the lake/pond (Table 10). As stratified lakes/ponds age, oxygen becomes ***depleted*** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment.

  In addition, during this season, and many past sampling seasons the lake/pond has had a lower dissolved oxygen concentration and a higher total phosphorus concentration in the hypolimnion (the lower layer) than in the epilimnion (the upper layer). These data suggest that the process of ***internal total phosphorus loading*** (commonly referred to as ***internal loading***) is occurring in the lake/pond. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion (**as it was this season and in many past seasons**), the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Depleted oxygen concentration in the hypolimnion of thermally stratified lakes/ponds typically occurs as the summer progresses.

Again, this may explain why the phosphorus concentration in the hypolimnion is ***greater*** than the phosphorus concentration in epilimnion. Since an internal source of phosphorus in the lake/pond may be present, it is even more important that watershed residents act proactively to minimize external phosphorus loading from the watershed.

The ***low*** oxygen level in the hypolimnion is a sign of the lake's/pond's ***aging*** and ***declining*** health. This year the DES biologist conducted the temperature/dissolved oxygen profile in ***July.*** We recommend that the annual biologist visit for the 2003 sampling season be scheduled during ***August*** so that we can determine how severe the oxygen is depleted in the hypolimnion ***later*** in the sampling season.

- **Table 11: Turbidity**

  Table 11 in Appendix B lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to page 19 of the "Other Monitoring Parameters" section of this report for a more detailed explanation.

  As previously discussed, the turbidity of the **hypolimnion** (lower layer) sample was elevated on the **July** sampling event. This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling. In addition, the turbidity of the **Brown Inlet** sample was elevated on the **August** sampling event. This suggests that the stream bottom may have been disturbed while sampling, or that soil erosion is occurring in this portion of the watershed.

DATA QUALITY ASSURANCE AND CONTROL

During the annual visit to your lake/pond, the biologist conducted a "Sampling Procedures Assessment Audit" for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual).

This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an ***excellent*** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an ***excellent*** job when collecting samples and submitting them to the laboratory this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

NOTES

- Monitor's Note (5/21/02): Cold, windy.
- Monitor's Note (6/25/02): All went well. Lake has much pollen on surface.
- Monitor's Note (9/24/02): Water level of lake is low. No water running at Russell, Billings, and Brown Inlets.

USEFUL RESOURCES

Changes to the Comprehensive Shoreland Protection Act: 2001 Legislative Session, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/sp/sp-8.htm

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Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm

The Lake Pocket Book. Prepared by The Terrene Institute, 2000. (internet: www.terrene.org, phone 800-726-4853)

Managing Lakes and Reservoirs, Third Edition, 2001. Prepared by the North American Lake Management Society (NALMS) and the Terrene Institute in cooperation with the U.S. Environmental Protection Agency. Copies are available from NALMS (internet: www.nalms.org, phone 608-233-2836), and the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Organizing Lake Users: A Practical Guide. Written by Gretchen Flock, Judith Taggart, and Harvey Olem. Copies are available form the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Proper Lawn Care in the Protected Shoreland: The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm

Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-2.htm

Use of Lakes or Streams for Domestic Water Supply, WD-WSEB-1-11, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/ws/ws-1-11.htm

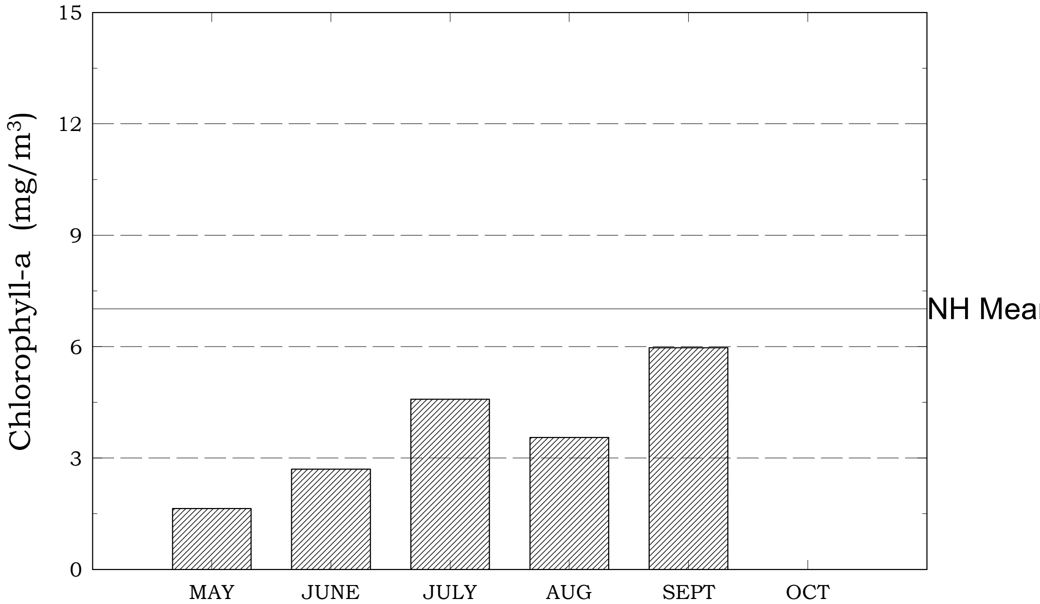
Water Milfoil, WD-BB-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-1.htm

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm

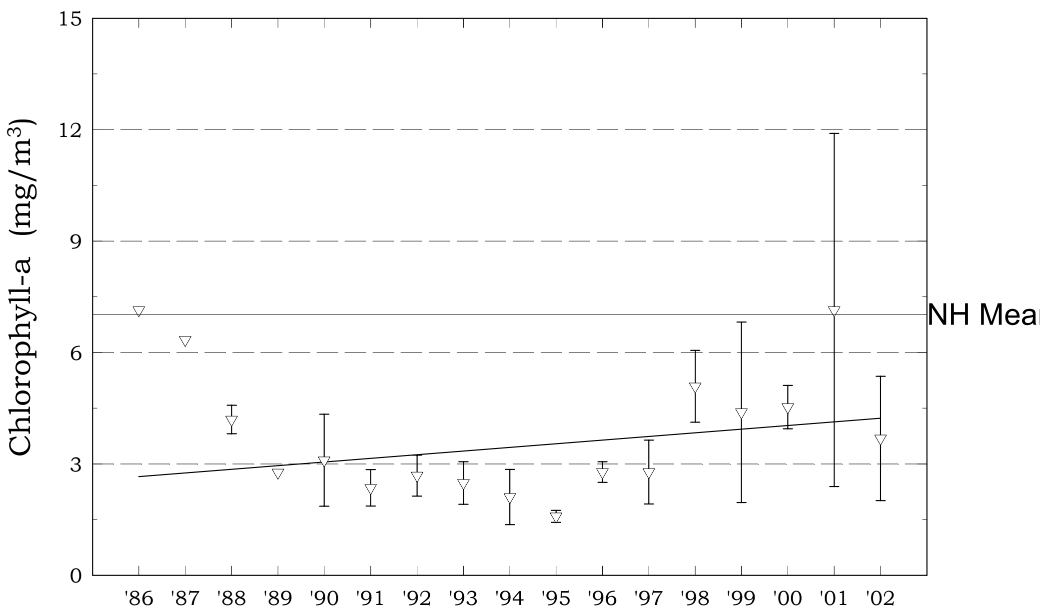
Appendix A: Graphs

Blaisdell Lake, Sutton

Figure 1. Monthly and Historical Chlorophyll-a Results



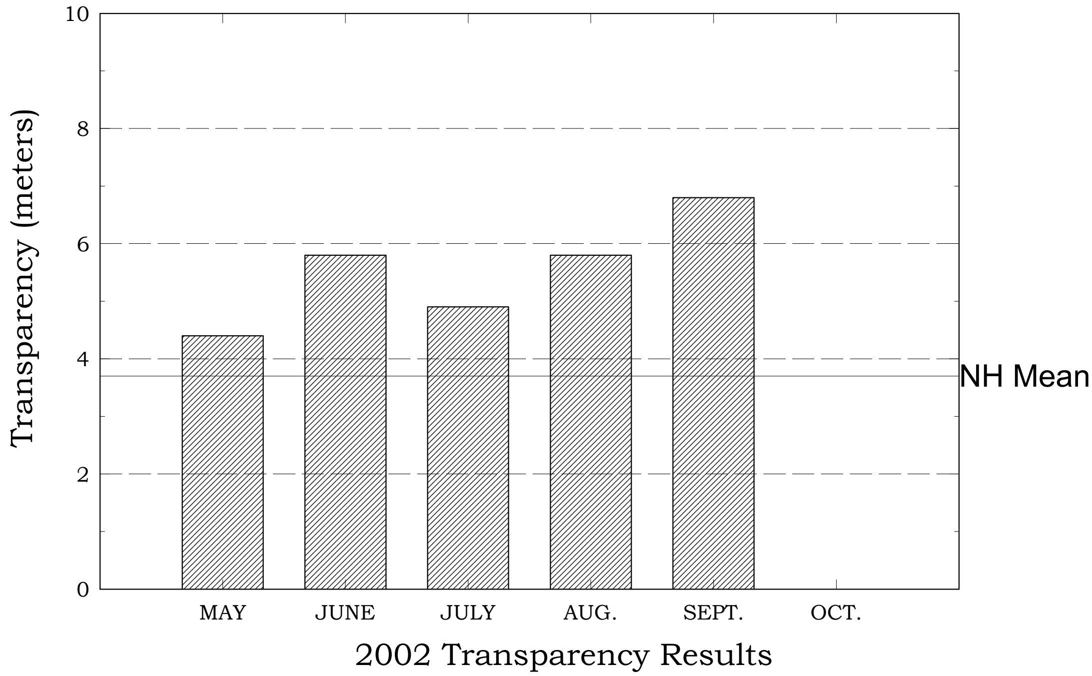
2002 Chlorophyll-a Results

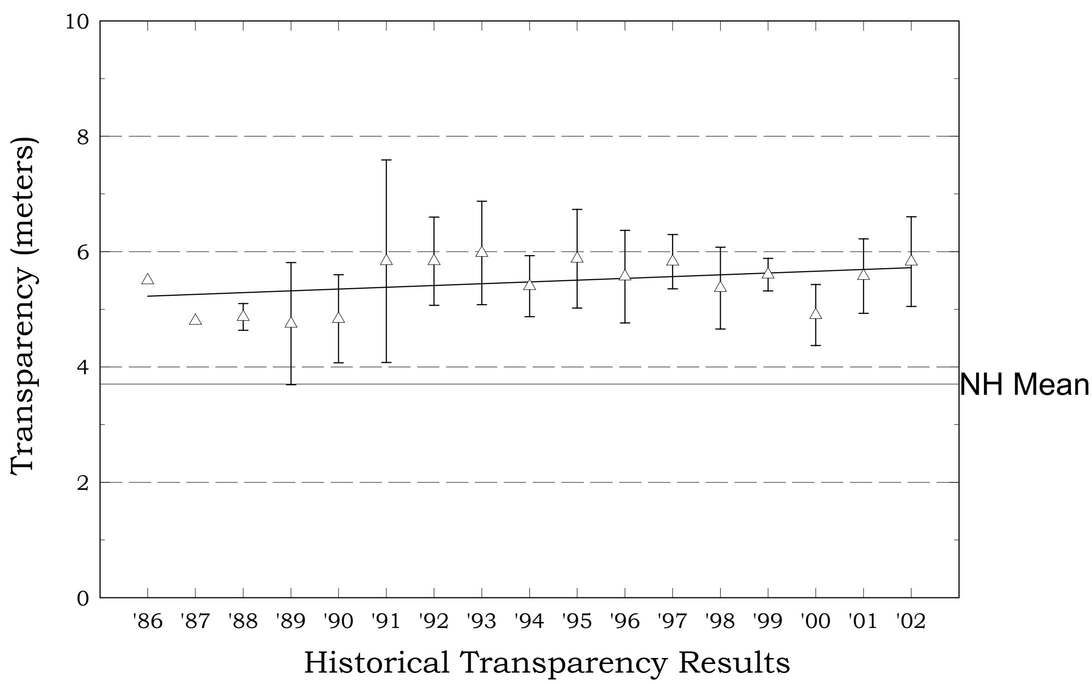


Historical Chlorophyll-a Results

Blaisdell Lake, Sutton

Figure 2. Monthly and Historical Transparency Results





Blaisdell Lake, Sutton

Figure 3. Monthly and Historical Total Phosphorus Data.